INDOOR FALL DETECTOR BASED ON DOPPLER RADAR

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Abstract

A smart fall detector based on a Doppler radar is presented aiming at non-invasive fall detector in home environment. A Continuous Wave (CW) signal is used to assess the changes in speed of different persons observed during daily activities which include: falling, walking, sitting down, standing up, random movement, and no movement. The speed measurements are introduced in a machine learning methodology to estimate a generic model that discriminates fall events from normal movements.

Keywords: Fall detection – movement classification – radar remote sensing.

1 Introduction

Fall incidents represent the second leading cause of injury for elderly people (60 years and older) [1]. A fall incident that occurs when a person is home alone might cause he/she to lay down for hours before help arrives.

In contrast to current wearable solutions (e.g., device with a button, accelerometers), non-invasive fall detection offers the main advantage that no action by the person is required.

2 Fall detector

A single tone at 5.8 GHz is used to detect the speed signals produced by different persons during daily activities (i.e., falling, walking, sitting down, standing up, random movement, no movement) exploiting the Doppler effect [2]. A movement classification based on a Least Squares Support Vector Machines (LS-SVM) framework combined with Global Alignment (GA) kernel [3] is applied to discriminate fall event speed signals from all other speed signals. As opposed to [3], where the technique is applied to classify signals consisting of one single activity whose starting and ending points are known, a sliding window is introduced to process signals consisting of multiple activities.

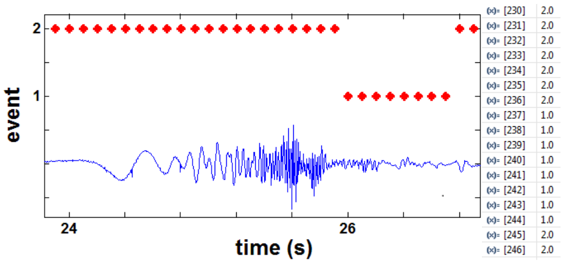
The LS-SVM classification model has been implemented using a TMDSEVM6678 Multicore Digital Signal Processor (DSP) platform.

3 Experimental results

A training set containing 90 activities measured from a single person is used to estimate a fall classification model. It was built dividing the activities in two main groups, namely fall events and normal movements. The model has been tested on 20 signals containing multiple activities acquired on three different test persons. A sliding window of 2 s with 95% overlapping is used to process the signals.

Fig. 1 shows the classification result of a fall event implementing the algorithm both in Matlab (Fig. 1a) and with the DSP (Fig. 1b). The experimental results equal in both cases and the event was classified as fall for eight consecutive windows of signal.

The experimental evaluations have shown a success rate in detecting fall events of 95% without reporting false positives.



(a) (b)

Fig. 1 – Classification results during a fall event implementing the algorithm both (a) in Matlab and (b) with the DSP. The fall is labeled as "1" while the normal movement as "2". Each dot in (a) indicates the class where a window of 2 s of signal has been assigned, and corresponds to the n-th position of the vector x in (b).

References

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